Another Cost-Effective Design Tool

This special issue of *IEEE Micro* emphasizes the concept of the embedded processor. In particular we present discussions of the high-end embedded processors that contain 32-bit programming models. These processors support high-performance applications such as local area network servers and 20-page/minute laser printers.

Most users don't see embedded processors. In fact, these processors often control a product not normally considered to be a computer. Designers program the highly integrated, commodity price-driven processor/controller to fit a particular range of applications. If there is a universally accepted definition of an embedded processor, we have not seen it. The best definition comes from looking at examples of how these devices are used.

Embedded processor applications include microwave ovens, laser printers, programmable scales, robots, navigation systems, and automobile antiskid braking systems, engine control, adaptive suspension systems, and audio systems. For years the computer industry has used embedded processors in smart terminals, disk controllers, and communications interfaces.

These processors can be the same general-purpose devices found in your favorite personal computer. However, demand is growing for low-cost processors specifically designed for embedded applications. These devices are, as a rule, variations of existing processors with some functions modified to reduce cost yet still allow the designer maximum functionality for a particular range of applications. In general, embedded applications tend to make use of smaller amounts of memory and make extensive use of EPROMs for program storage. Some embedded applications, such as laser printers and plotters, can access over 2M bytes of memory.

Dataquest, a respected market research firm, estimates that in 1987 over five embedded controllers were sold for every microprocessor sold. That estimate translates to 90 million microprocessors and about 500 million embedded processors sold last year. Obviously, this area of technology cannot be overlooked by the industry or by the practicing design engineer.

In this issue we offer technical and explanatory information about five processors, which we consider to be embedded processors: the 80376, VL86C010, TMS34010, R3010, and 80960. Intel authors discuss how the 80376 was derived from the 80386 in such a way that the user can depend on existing software development tools. They also discuss a companion multifunction chip and give several application examples.
Texas Instruments originally designed the 34010 as an embedded graphics processor. The 34010 designers used general-purpose RISC ideas and added hardware modules to supply DRAM refreshing and bitmap graphics.

VLSI Technology's author recounts the development of a new embedded controller, the VL86C010, which works in an application environment that is interrupt and I/O intensive.

MIPS Computer Systems presents its newly developed RISC floating-point coprocessor, the R3010. This processor is remarkable because of its impressive performance figures.

We round out the issue with a second Intel article on the new architecture of the 80960 embedded processor, which efficiently executes code. The high-performance 80960 incorporates many RISC processor ideas and includes an on-chip floating-point unit.

The future for embedded processors looks extremely bright. We anticipate that future design engineers will consider these processors to be one of their fundamental design building blocks. At the present time embedded processors support a variety of applications that would not be possible—or at least would be extremely difficult—to carry out without their use.

The addition of this improved technology impacts the design process and the way that design engineers think about their designs. With the embedded processor the design engineer gains another cost-effective tool for efficient system design.

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